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In the past year, there have been 3 major technical accomplishments at Knoxville College. The first is the establishment of a Computational Plasma Physics facility. This facility, utilizing state of the art Sun Microsystems and P.C. equipment is a rarity among HBCU's and was literally put together as the project progressed during this first year. The purpose of this grant was two fold. The purpose was to bring Internet capabilities to the Knoxville College campus for purposes of performing computational AFOSR research, and to bring advanced UNIX computing capabilities to the campus and link them with similar capabilties at the University of Tennessee, Knoxville using Internet.



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Progress Report
on
AFOSR Research Grant #F49620-94-1-0211

Year 2
April 1, 1995 - May 31, 1996

And

Final Report
April 1, 1996 – May 31, 1997

## Introduction

This document details the startup of a joint research project involving both Knoxville College and the University of Tennessee. At the present time joint research is beginning to take hold with the free flow of students and faculty members between the two institutions. The original concept was to have the two sites perform complimentary projects, drawing on the expertise of both schools. In this technical year, several goals were met in bringing Knoxville College on line in the plasma physics research area. These goals include:

- Development of a Knoxville College Plasma Physics computational facility.
- Active participation in the OOPIC code development.
- Development of an Internet Information Web Server to Publish both the OOPIC code and Documentation.
- Development of a Joint Research Facility with the University of Tennessee.
- Train and transition 3 undergraduate students in computation physics modeling through their undergraduate degree and transition these students to a graduate program.
- Employ 6 undergraduate students for work in plasma physics.
- Involve new faculty in experimental and computational work.
- Recruit 3 of the nations top African American graduate students to the program.

These goals were accomplished in partnership with the University of Tennessee, Knoxville. The basic program involves the employment of Knoxville College undergraduates and faculty members working along side of University of Tennessee graduate students and faculty members to effect a research mentoring situation. This has been very successful as 50% of the students in the program have transitioned to the Masters Program at UTK.

## Technical Accomplishments

In the past year, there have been 3 major technical accomplishments at Knoxville College. The first is the establishment of a Computational Plasma Physics facility. This facility, utilizing state of the art Sun Microsystems and P.C. equipment is a rarity among HBCU's and was literally put together as the project progressed during this first year. The purpose of this grant was two fold. The purpose was to bring Internet capabilities to the Knoxville College campus for purposes of performing computational AFOSR research, and to bring advanced UNIX computing capabilities to the campus and link them with similar capabilities at the University of Tennessee, Knoxville using the Internet.

It was decided to accomplish this task by purchasing portions of the equipment, software, and equipment through the University of Tennessee. This purchasing of these services through UTK resulted in a 43% discount from Sun Microsystems. This also allowed us to use all of the UTK site licenses for network services.

Purchased on a secondary grant were, ten Sun Workstations 3 Sparcstation 10's and 7 Sparcstation LX's with the associated support equipment. In addition there were

purchased, 7 IBM compatibles for the Division of Natural Science, 1 Tektronix color laser printer, and 1 CD-ROM maker along with additional software to network these machines to the Sparcstation network.

In order to make the maximum use of the equipment for research, 3 of the Sparcstation 10's were designated for server applications. One is permanently attached to the University of Tennessee with the second on site at Knoxville College to act as local server for disk, networking, and print services. The third acts as backup server at Knoxville College and master research terminal. The 7 Sparcstation LX's are being used for student based research and faculty Internet access. Name and Gateway services are being provided by a Sparcstation 5 that was purchased by MIS funds from the College.

All of the machines purchased have been interconnected using standard TCP/IP protocols. At present the College has wired McKee Hall, Wallace Hall, and the Student Center for Internet Services from internal College funds. Access to both laser and color print services are available from all of the Sparcstations. These machines are cross-linked with counterparts on The University of Tennessee campus. At present the Knoxville College mounts and has access to all of the UTK forest domain drives through the machine stationed on the UTK campus with no reverse access set up. This increases the storage capacity of Knoxville College while maintaining the College's independence.

This equipment was then used to establish a World Wide Web site for both Knoxville College and the AFOSR OOPIC project. Figure 1, shows the basic home page with the AFOSR section. Figure 2 shows the basic OOPIC home page. Information about the program as well as information about AFOSR activities in plasma physics can be obtained at this site. Figure 3 shows the options now available on OOPIC. It is now possible to down load the source code, the 32 bit binary code, the OOPIC Developers Manual and the OOPIC Algorithm Manual. Figure 4 shows the on line algorithm manual.

The final major technical accomplishment has been to develop atmospheric corona equipment for use in materials processing, and other applications. This effort lead by Dr. Igor Alexeff at the University of Tennessee, truly illustrates the dual nature of the program and the cooperation between the institutions.

In addition to these major accomplishments, several minor technical services have been accomplished. These services include:

- Assisting George Mason University in GUI development.
- Serving as a development site repository for the OOPIC code.
- Serving as project coordinator between GMU/FMT and UCB/BRA.
- Serving as phone meeting coordinator between GMU/FMT and UCB/BRA

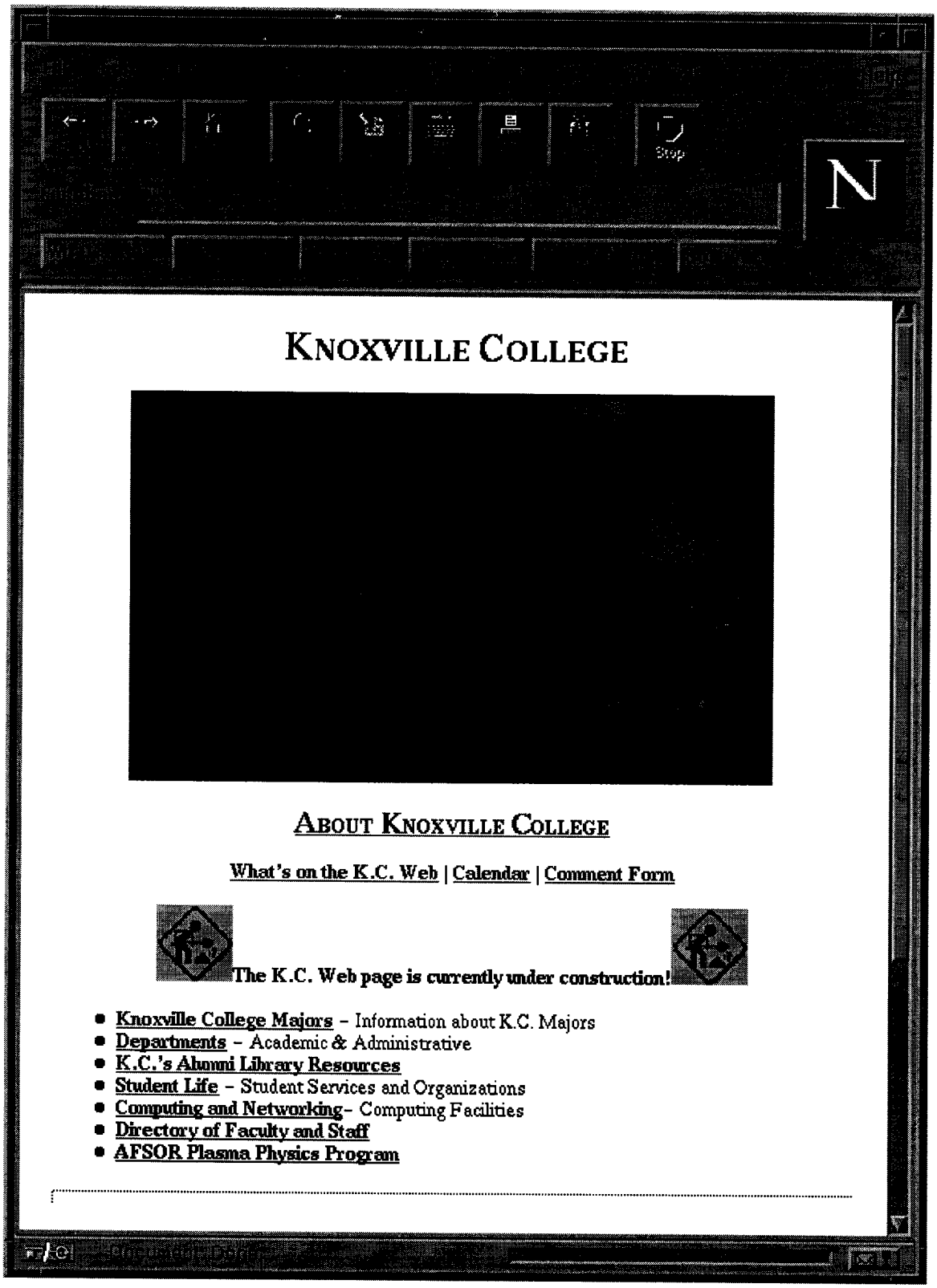


**Figure 1 Knoxville College Home Page**

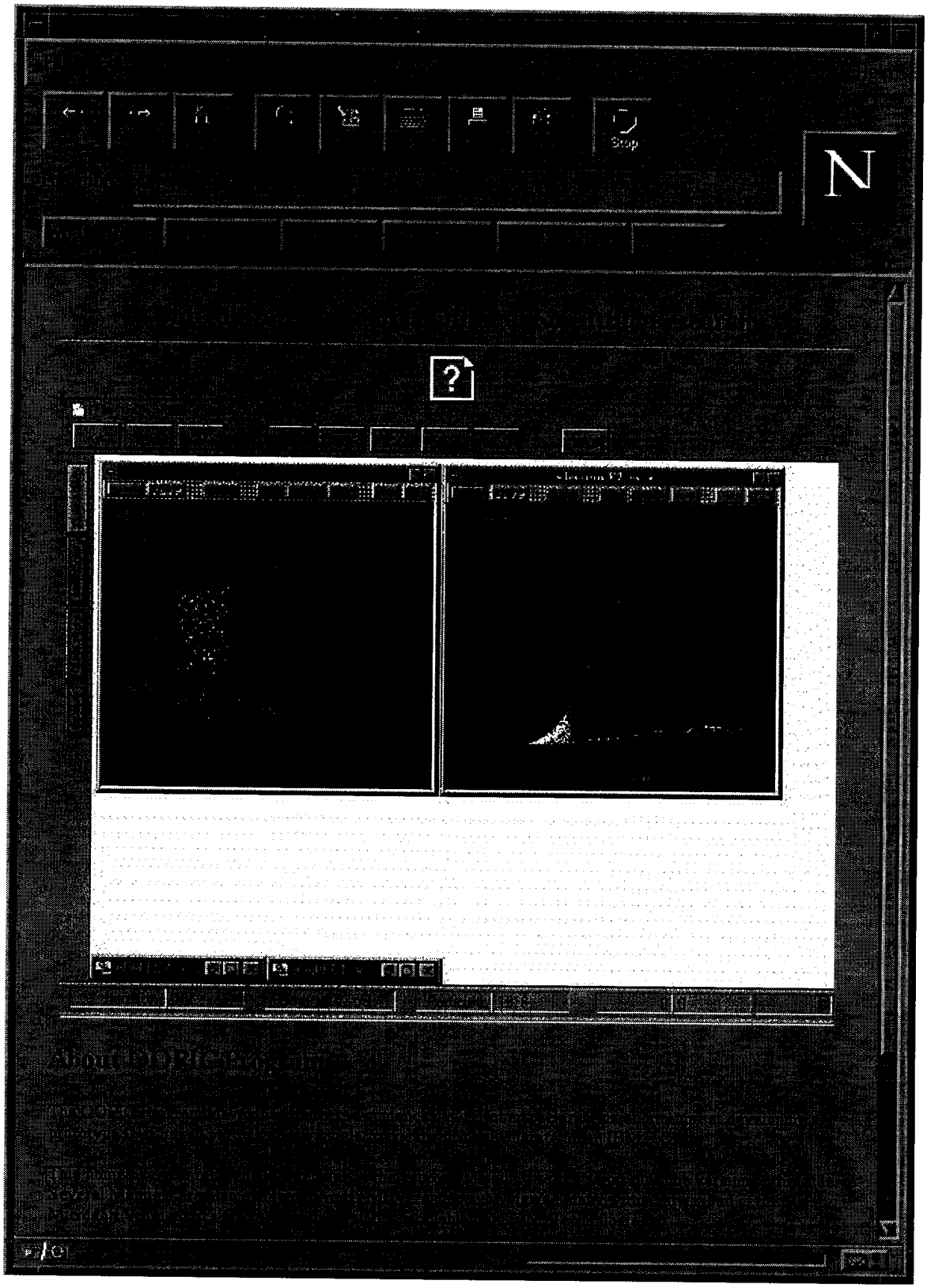


**Figure 2 AFOSR OOPIC Info Document**

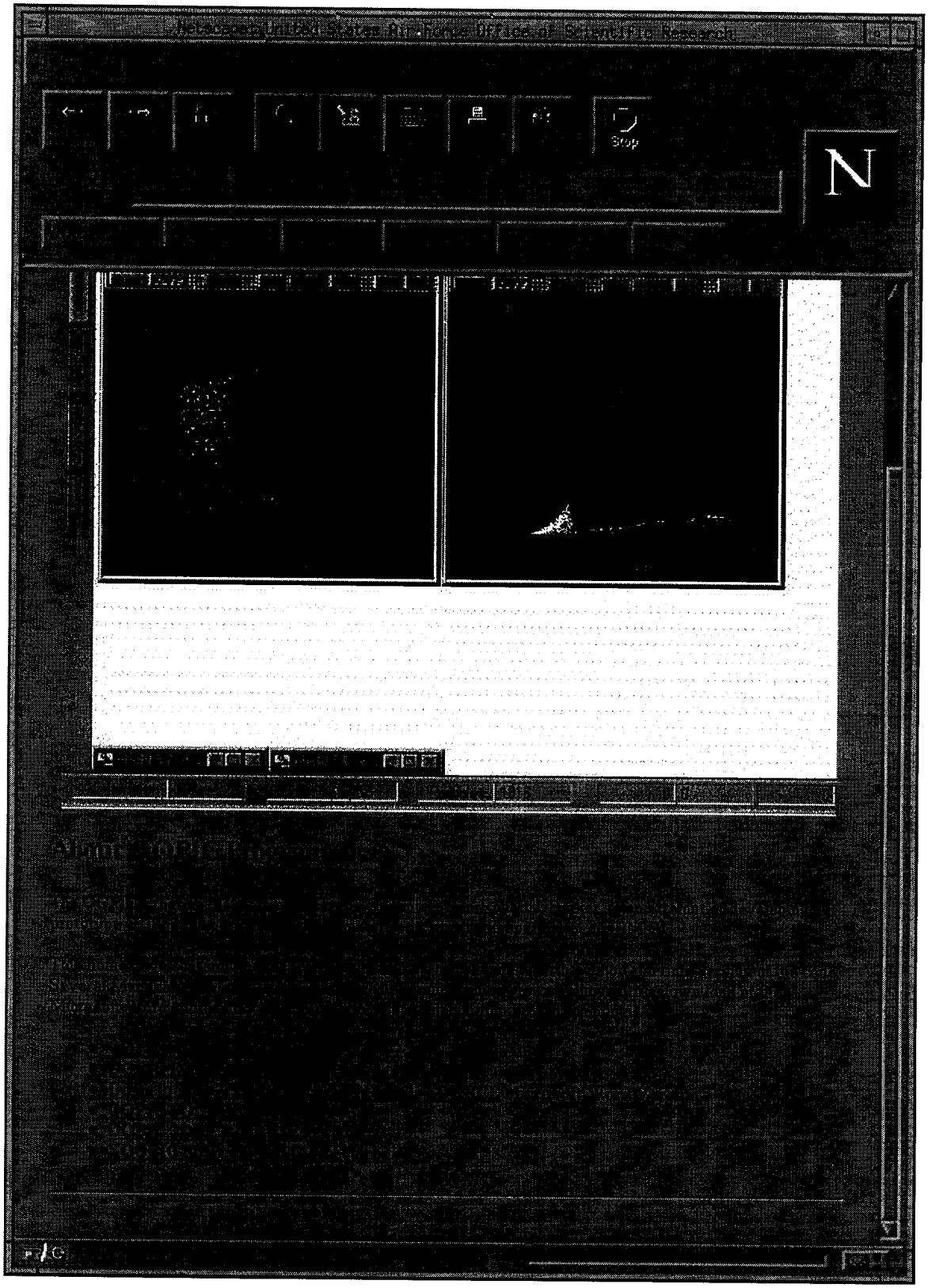

**Figure 3 OOPIC Down Load Options**

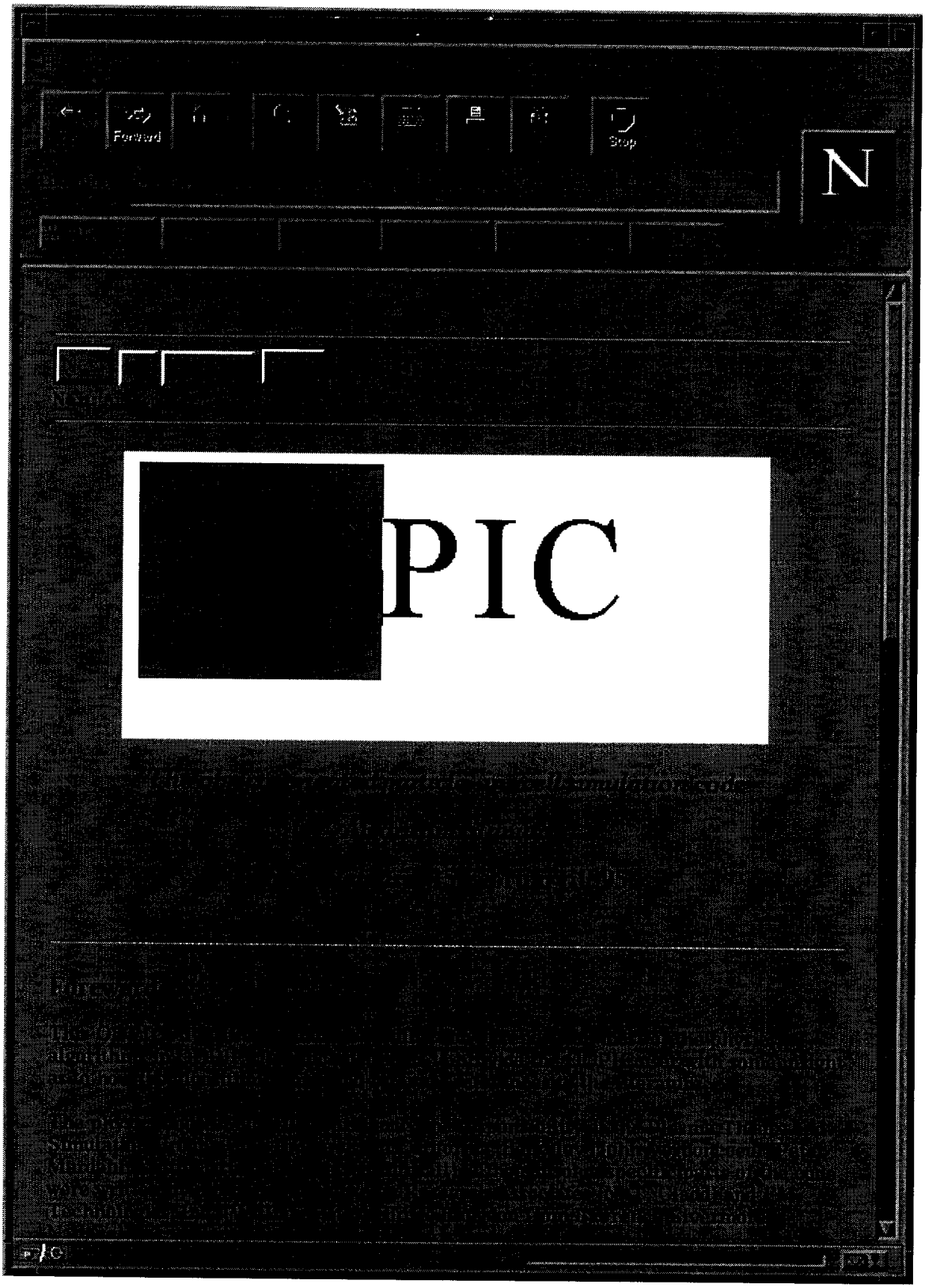


**Figure 4 OOPIC Algorithm Manual**

## University of Tennessee Research

The work that was accomplished during the AFOSR Knoxville College contract, comprised the following:

1. The most impressive work that included several invited papers at SPIE conferences, was the theoretical demonstration of stabilization of plasma-filled microwave tubes by using a transverse ion flush. The work demonstrated that the growth of low frequency electron beam-background ion instabilities could be greatly reduced by a transverse ion flow (FLUSH). This transverse ion flow was shown to consume little energy compared to that present in the electron beam. The use of plasma in microwave tubes was demonstrated to increase the efficiency in previous work at the Naval Research Laboratory.

2. The second piece of work included Mr. Kang's (Professor Alexeff's student) MS thesis on plasma stealth antennas. These antennas electrically disappear when they are not used, and so do not return a reflected signal from probing RADAR. The Patriot scientific company picked up this work for a phase 1 SBIR.

3. The third piece of work included Mr. Kang's PhD thesis on a polyphase plasma lamp. A computer simulation showed that a polyphase lamp produced a much less distorted voltage-current wave form than a single phase lamp. The present lamps produce a distorted wave form that causes high frequency noise. This noise interferes with adjacent electrical apparatus.

## Problem Areas

Over the course of this research several problems areas have arisen, due to the lack of adequate administrative infrastructure at Knoxville College. These problems include:

- Lack of an adequate inventory system.
- Lack of an adequate grants management system.
- No established purchasing system.
- Instability in the College Administration.

Many of these difficulties were overcome with the aid of College personnel but on the whole the lack of proper procedures caused a slow down of grant progress.

## Summary

Over all the technical progress has been very productive. This has been a unique experience starting a research program from scratch.